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REDUCING DIFFUSION LIMITATION SHIFTS THE DOMINANT NITRATE REDUCTION METABOLISM FROM INCOMPLETE DENITRIFICATION TO DISSIMILATORY NITRATE REDUCTION TO AMMONIUM

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Soil is a key compartment for the global Nitrogen cycle, with bacteria playing a major role both in nitrification and denitrification. This cycle is often considered at a large scale, but it is the conditions experienced 'locally' by the bacteria that set what type of metabolism can take place. These conditions, and especially the redox conditions, are likely controlled by diffusive processes.

In this study we investigate how modulating diffusion limitation impacts on biological nitrate reduction in a soil system. To this end, we have constructed an array of columns, all fed a solution of nitrate and containing the same amount of litter-rich soil encased in alginate – but varying in how the soil aggregates are spatially distributed and in the amount of potentially reactive soil aggregate surface. The effluent was analyzed for nitrate-, nitrite-, ammonium-, nitrous oxide-, and TOC-concentration, pH and amount of microorganisms. In addition, at the end of the after the experiment the columns were analyzed using qPCR targeted at key genes in the denitrification pathways.

The results show that going from a high level of diffusive limitation to a low level shifts the system from incomplete denitrification with production of nitrite and nitrous oxide to DNRA. Diffusion limitation thus impacts strongly Nitrogen biogeochemical pathways in this system rich in organic carbon. This highlights the importance of microniches in soil functioning and in the global biogeochemical cycle.